AD-A038 374 NAVAL HEALTH RESEARCH CENTER SAN DIEGO CALIF F/G 6/11
MEASUREMENT OF HABITABILITY,(U)
MAY 74 E K GUNDERSON, B W MCDONALD

UNCLASSIFIED 74-47 NL

| OF |
AD
A038 374

END

DATE
FILMED
5-77

MEASUREMENT OF HABITABILITY

E. K. E. GUNDERSON
W. MC DONALD

REPORT NO. 74-47

May 74

12p.

R0001

MR000104 1

NAVAL HEALTH RESEARCH CENTER
SAN DIEGO, CALIFORNIA 92152

NAVAL MEDICAL RESEARCH AND DEVELOPMENT COMMAND
BETHESDA, MARYLAND

391 642

Measurement of Habitability

E. K. Eric Gunderson, Ph.D.,[1] and B. W. McDonald, Ph.D.[2]

Dr. McDonald and I will describe a series of studies in which we are attempting to develop quantitative approaches for evaluating and comparing human environments. These are natural or realistic environments in the sense that people actually live in them. The primary focus of the study is on the living and working environments of Navy ships. Ship habitats have certain unique features, such as involving the individual twenty-four hours a day and encompassing all of his activities, including work, recreation, sleeping and eating. Furthermore, the periods of inhabiting the shipboard environments are rather long. Sailors spend from six to eight months aboard these ships during overseas deployments with only short, intermittent stops ashore. Thus, they may be confined entirely to these habitats for several weeks at a time.

Ships are natural ecological units in the sense that diets, water supply, climatic conditions, and infectious agents that might affect health and well-being are common to inhabitants of these communities. Also, ships provide handy experimental units in that they have similar missions, crew compositions, organizational structures, and living conditions and, thus, provide replicated units for statistical analyses; experiments can be repeated over a series of ships.

The research that I am going to describe briefly is a large-scale project

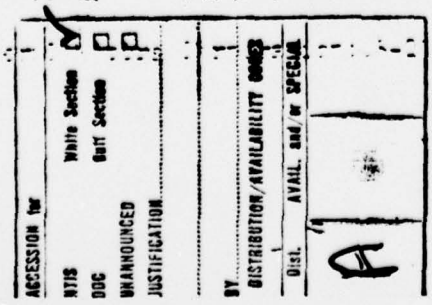
---

Presented to the California Council of the American Institute of Architects, Conference on Habitability, Monterey, California, November 1973.

[1]Head, Epidemiology and Operational Psychiatry Division, Navy Medical Neuropsychiatric Research Unit, San Diego, California 92152.

[2]With General Motors Corporation; 8-206 G.M. Building, Detroit, Michigan.

concerned with environmental, organizational, and social stresses that affect health and behavior. The present discussion will be limited primarily to the environmental stresses or habitability features of the ships studied. This work arose out of earlier studies which involved several combat ships deployed overseas. We found that illness rates among these ships were quite different, even though the ships were similar in type, size, mission, etc. Illness rates varied from ship to ship in a ratio of 2 to 1 in certain instances, and we had no way of explaining these differences in terms of attributes of the ships; the composition of the crews, operational missions, medical facilities, and so on, tended to be similar. We were led to hypothesize that differences in both the physical and the social environments might account for the large differences in illness and accident rates observed. Therefore, we initiated a new research project supported by the Navy Bureau of Medicine and Surgery and the Office of Naval Research to test the general proposition that illness and accident rates and job attitudes could be explained to some degree by differences in ships' environmental and organizational characteristics. The first year of this project was a pilot study oriented toward developing research instruments and testing them prior to conducting a major study. A number of research instruments were devised and tried out on 13 ships and approximately 1,200 crew members. Some of the earlier results suggested that we might be on the right track. When we plotted the 13 ships on two factors, illness rate and mean job satisfaction, the three ships with the most extreme scores differed markedly in their operational characteristics during overseas deployments. One ship had a major fire, the second ship burned and sank, and the third ship



had a bloody race riot. This type of critical incident information, while merely suggestive, encouraged us in the expectation that there might be important factors in the organizational structure and functioning of these ships that accounted for breakdowns in their performance.

The current study involves 20 Navy combat ships and approximately 5,000 crew members. Broadly, we are concerned with all the features of the shipboard environment that affect illness and accident rates, job performance, and job satisfaction or morale. Research methods include questionnaires, interviews, rating forms and checklists, observational methods, ships' records, and personnel and medical data. Three sources of information pertain specifically to the evaluation of the habitability features of the ships. The Ships Evaluation Form is a checklist that contains a long list of specific environmental characteristics of the ship. A research staff member systematically inspects the ship and enters all pertinent information regarding specific features of sleeping areas, sanitary facilities, messing areas, and recreational areas or lounges. He records such things as the square feet of floor space; the number, type and arrangement of all fixtures in these spaces, including bunks, lockers, privacy panels, etc.; the type of lighting and wall colors, and the conditions of cleanliness and neatness in these spaces. Although we are unable to make detailed measurements of noise and heat, disturbing noise conditions and extremes of temperature are noted by the trained observer. We attempt to identify in a rough way the most extreme deviations in environmental conditions. At the same time that the observer inspects the various spaces on the ship, he photographs all of the same spaces. Following a prescribed set

of procedures he obtains photographs that provide a visual record of the same spaces that were surveyed and rated. This photographic survey method has certain interesting possibilities that we are trying to exploit further. First of all, in sorting and examining these photographs and comparing them across ships we found that it was possible to develop rough scales representing various degrees or quantitative levels of environmental quality. We are extending the range of conditions included in these photographic scales by going to other ships in the fleet to find some extremely poor conditions as well as extremely good conditions which gives us a wide-range of differences in habitability status. We can utilize these scales as standard stimulus reference sources and have judges compare photographs from any specific ship with the sets of standardized photographs. These judgments can provide quantitative descriptions of particular environments.

The third major source of habitability information in these studies is a questionnaire survey method which includes approximately 150 specific items that the crew members themselves fill out. This procedure provides crew members' perceptions of the same spaces that were previously evaluated by trained research staff on such dimensions as crowding, privacy, lighting, color, temperature, noise, recreational facilities, etc. One of our concerns is to compare the objective assessments of the environment, as provided by observers' ratings and photographic records, with the perceptions of the crew members who actually use the spaces. Generally, crew members' perceptions tend to agree quite well with the observations recorded by the trained staff. There are some dimensions on which agreement is not very good, however. We feel that

under controlled circumstances and using certain dimensions crew members' perceptions are good and valid reflections of the objective properties of the environment; on other dimensions crew members' perceptions may not be accurate estimates of environmental characteristics. Because crew members' perceptions are easy and quick to obtain they provide a simpler, more economical method of environmental assessment than surveys by trained researchers.

Before conducting environmental assessments on a large-scale, it seems important to determine what sources of data are valid and to establish methods for achieving an adequate consensus as to important features of the environment. In demonstrating the use of these methods in comparing environments, I would like to sample data obtained from two ships in our current study. These ships were not selected at random but rather because they were quite different and provided consistency of data from various sources. Observers in going through these two ships took measurements of the square feet of floor space in the berthing compartments and counted the bunks, lockers, chairs and tables in each space. From these simple and direct measurements we were able to derive indices relevant to differences in habitability and environmental quality. For example, we can consider the gross square footage per man within the berthing compartments on one ship, Ship A, which was $14\frac{1}{2}$ square feet per man as compared to $16\frac{1}{2}$ square feet per man on the other ship, Ship B. However, the most important factor in this comparison was that Ship A had much more effective use of its floor space in that 25-50% of the space was open and free of fixtures, bunks, etc., while Ship B had less than 25% of the berthing space and sleeping areas as open, free space. The men on Ship A perceived their

berthing compartment as less crowded than the men on Ship B. The messing area on Ship A provided about 5½ square feet per man versus approximately 2-1/5 square feet per man on Ship B. This discrepancy suggests that the crew members on Ship B with much less messing space available would stand in line longer and experience much more frustration and dissatisfaction with the messing facilities than men on Ship B; this indeed was the case. Ship A had a comfortably furnished and fairly pleasant lounge area whereas Ship B had no lounge at all. Although a number of small areas were designated as lounge areas on Ship B, these consisted of perhaps a table and two chairs or sometimes a TV set and nothing more. There were also many other differences with respect to recreational facilities. For example, the number of books and magazines and the storage available for recreational supplies, were quite different on the two ships. These differences were clearly reflected in the crews' perceptions of the diversity and adequacy of recreational facilities. Using the photographs of the two ships as stimulus sources, Ship A was generally rated by the authors as more orderly, clean, pleasant and attractive than Ship B.

The above examples provide an introduction to the kinds of measurements that we are making, and I have indicated major differences between two ships of the destroyer type which were deployed overseas and operational at the time of the testing and observations. For these two ships there was a high degree of consistency in the physical evaluations and measurements made by research staff and the perceptions of crew members who inhabited these spaces.

I would like now for Dr. McDonald to continue and to describe in more detail shipboard environments and to use photographs to illustrate the kinds

of environments we are talking about.

Dr. McDonald: Some of the environments that you have seen earlier today, such as those presented by Dr. Haynes, are quite different from the types of environments that we are talking about, and I hope that I can illustrate some of the differences for you. Secondly, I would like to discuss further some of the tools we are using and the types of differences that we have attempted to measure. Finally, I would like to show you a questionnaire that Dr. Gunderson and I have developed during the past few days for your use in evaluating the buildings that you design. We would like to hand these out to you and achieve two things: (1) obtain your reactions to the questionnaires and (2) try to talk you into using this questionnaire or one like it on an experimental basis.

I'm going to show you a number of slides of the living and working conditions of some of the ships in our study, and I will describe these conditions for you as I show the slides. Remember that these are actual conditions, usually photographed without notice. First, I would like to show you sanitary facilities that are typical of some of the ships in our sample. This particular ship has less satisfactory or less acceptable conditions than some of the others. This is a restroom area with some of the lavatory facilities where men shave in the morning, and this area serves a fairly large number of men. The sinks are of stainless steel because they are easy to keep clean, and they don't break when the guns are fired which is very important. As you can see, there are some very untidy conditions and this is one example. On the other hand, in the next slide we see a very satisfactory sanitary facility with stainless steel sinks, a large mirror, and an enclosed panelling. However, the

mirror shatters when the guns go off, and this is less than desirable. Designing environments for these ships, particularly sanitary facilities, presents a number of difficulties because they should be acceptable to the personnel using them and should withstand the type of treatment they will receive. Also, in this area there is the problem of odors which may be unpleasant and difficult to eliminate. I will show you another sanitary facility which is very satisfactory; it is clean, neat, and the fixtures do not break.

I would like to show you a typical messing or eating area, although this one is slightly better in some respects than the average. The chairs are fixed so that they don't slide and tables are bolted to the floor but they do have the ability to swivel. Typically in these areas, movies will be shown in the evenings in addition to their use for eating during mealtimes. The fixtures have to be very stable and in the past chairs usually were bolted to and facing the tables, but this made it very awkward for the audiences to view movies. Here is an example of a different type of arrangement which is quite acceptable and nice in appearance. It has independent tables, swivel chairs, beautiful table cloths, and is clean and easy to maintain.

snave Here is another messing facility aboard a different ship which is much more difficult to maintain. Tables and chairs are movable, but the ship is large and, therefore, fixtures can move about more easily. Larger ships can accommodate fixtures which slide about while the smaller ships, such as destroyers, cannot. The lighting level in this space is less than one might consider acceptable in spite of the fact that there are dozens of pictures and the general decor is attractive.

This is an Officers' Mess. Conditions are somewhat different in that this is a panelled room with overhead or false ceilings which we did not see in other areas, and there is linen and silver-plated flatware on the table. Enlisted messing facilities had exposed wires and lighting and less attractive arrangements.

I should like now to direct your attention to the sample Architectural Evaluation Questionnaire which has been distributed to you. This is not presented as a well-constructed, valid instrument -- far from it -- but it is offered in an attempt to demonstrate that even a brief and simple questionnaire might provide some useful feedback from those who use a particular environment, such as a building or office space, with respect to specific environmental features that affect the individuals concerned. It is our impression that architects and environmental designers or engineers rarely obtain any kind of detailed or systematic evaluations from those who actually use or inhabit their products. As behavioral scientists we feel that not only extraterrestrial space vehicles and Navy ships should be functionally evaluated in terms of their inhabitants' perceptions and experiences, but that business offices, homes, and other types of structures might be examined in similar fashion. Buildings, offices, and ships are settings for human behavior which to some extent determine human efficiency and satisfaction, and we should ask with greater urgency than ever: Are these behavioral settings well-suited to the people who inhabit them? One relevant, and usually neglected, source of information is the perception of the user. Our knowledge of environments, how they vary, and how they affect human behavior is still very limited. We need more information about psychological reactions to environments and how environments attract (or repel) and shape the behavior of people who inhabit them.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER 74-47	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* Measurement of Habitability		5. TYPE OF REPORT & PERIOD COVERED Interim 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) E. K. Eric Gunderson and Blair W. McDonald		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Navy Medical Neuropsychiatric Research Unit San Diego, California 92152		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS MR000.01.01-6007
11. CONTROLLING OFFICE NAME AND ADDRESS Bureau of Medicine and Surgery Department of the Navy Washington, D.C. 20373		12. REPORT DATE May 1974 13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release, distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

Presented to the California Council of the American Institute of Architects, Conference on Habitability, Monterey, California, November 1973.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Habitability
Environmental stress
Morbidity
Environmental effects
Human ecology

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Quantitative approaches to the evaluation of human environments are discussed and large-scale studies of habitability, environmental stresses, and health aboard Navy ships are described. In earlier studies illness rates were found to vary considerably from ship to ship, and detailed investigations were undertaken of differences in physical and social environments that might account for the large differences observed in accident and illness rates. Major sources of data were systematic observations by trained research staff,

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-014-6601

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

Block 20 continued

questionnaires reflecting crew's perceptions of living and working areas, photography of the same spaces, and ship's records, including dispensary visits. Comparisons were made of two ships on quantitative environmental indices and crew's perceptions, and examples of varied shipboard environmental conditions were presented. A sample questionnaire for evaluating human habitats was offered for purposes of illustration.